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A Two-Dimensional Electron Gas at the Spinel/Perovskite Interface of γ-Al_2O_3/$SrTiO_3$ with Carrier Mobility Exceeding 100,000 $cm^2V^{-1}s^{-1}$

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The discovery of two-dimensional electron gases (2DEGs) at the heterointerface between two insulating perovskite-type oxides, such as $LaAlO_3$ and $SrTiO_3$ [1], provides opportunities for a new generation of all-oxide electronic devices [2]. Key challenges remain for achieving interfacial electron mobilities much beyond the current value of approximately 1000 $cm^2V^{-1}s^{-1}$ (at low temperatures). Here, we create a new type of 2DEG at the heterointerface between $SrTiO_3$ and a spinel γ-Al_2O_3 epitaxial film with compatible oxygen ions sublattices [3]. Electron mobilities more than one order of magnitude higher than those of hitherto investigated perovskite-type interfaces are obtained. Particularly, electron Hall mobilities as large as 1.4×10^5 $cm^2V^{-1}s^{-1}$ and n_s as high as 3.7×10^{14} cm^{-2} at 2 K is obtained at this spinel/perovskite complex oxide interface [3]. The spinel/perovskite 2DEG, where the two-dimensional conduction character is revealed by quantum magnetoresistance oscillations, is found to be strongly coupled to interface-stabilized oxygen vacancies confined within a layer of 0.9 nm in proximity to the interface. Our findings pave the way for studies of mesoscopic physics with complex oxides and design of high-mobility all-oxide electronic devices.

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